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Diurnal activity rhythms and time budgets of captive Qinling golden takin (*Budorcas taxicolor bedfordi*) in the Qinling Mountains, Shaanxi, China

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Abstract: In July 2006, the diurnal activity rhythms of 13 heads of captive Qinling golden takin were observed in Shaanxi Provincial Centre for the Breeding and Conservation of Rare Wildlife (SPCBCRW) at daylight (from 9:00 am to 4:00 pm in July). The behavioral ethnogram was identified through observation at the sampling site, with the behaviors of golden takin recorded at 5 min interval using instantaneous scannable sampling method. The results indicated that the resting of golden takin took an important part in the daylight activities. Meanwhile, drinking and urinating and defecating were 1.92 and 0.54 and 0.92 times per head per day. Ambient temperature had a strong effect on the diurnal activity rhythms of golden takin. The diurnal activity rhymes were affected by ages of the animals effectively, which was expressed through differentiation of the time budgets. Moreover, different individuals in the same population showed some non-synchronously activity rhythms.

Keywords: Captivity; Diurnal activity rhythm; Golden takin; *Budorcas taxicolor bedfordi*; Time budget

Introduction

The golden takin (*Budorcas taxicolor*) is found in Eastern Tibet, Sikkim, Bhutan, northern Assam, northern Burma, and central and southern China (Nowak 1999). The Qinling golden takin (*Budorcas taxicolor bedfordi*), a subspecies of golden takin, exists only in the Qinling Mountains, western China. Since 1960s, many researches have been carried out on the ecological habit, classification and distribution, appetite, choice of living conditions, population structure, and other behaviors of golden takin (Hu 1980; Wang 1987; Ge 1988; Ge 1989; Schaller 1986; Wu 1986; Wu 1990; Yuan 1990; Xiao 1991; Huang 1996; Zeng 1998; Zeng 1998; Song 1995; Song 1995; Deng 1981; Deng 1984). Recently, Zeng *et al*. (2001) analyzed the activity rhythms of the Qinling golden takin in spring and summer, but the observation merely was based on the wild conditions. Up to now, there was no report on captive Qinling golden takin and its time budget worldwide. Nevertheless, Zeng's study not only reported the diurnal activity rhythms of the captive Qinling golden takin, but also revealed the ruminating time-percentage per day in the golden takin. And for the first time, primary data were obtained such as how many times per day of drinking, urinating, and defecating activities. The aim of this project is to provide the basic data on daily activity rhythms and time budgets of the Qinling golden takin.

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Materials and methods

General information

The research site is located in Shaanxi Provincial Centre for the Breeding and Conservation of Rare Wildlife (*SPCBCRW*) on the north slope of the Qinling Mountains in Zhouzhi County, Shaanxi Province, China (108°14′–108°18′E, 33° 45′–33°50′N). The average temperature of this region is 6.4°C, with an average high temperatures of 29.7°C and average low temperatures of -19°C. The mean annual rainfall is 1000 mm. During the course of our research, the average temperature ranged from 28.5°C to 21.5°C. Temperature measurements were taken with a standard thermometer. The captive Qinling golden takins were housed in a concreted enclosure with area of 500 m^2 in open field. They were fed twice a day, at 9:00 a.m. and 4:00 p.m. The golden takins were given with dry (fodder) and moist plants as needed.

Materials and methods

The basic information of the 13 heads of Qinling golden takins is listed in Table 1, with part of it as ID characteristics. During observations, the observers stood in front of the takin enclosure and kept at a distance of 10 m. The observation time persisted from 9:00 a.m. to 4:00 p.m. in July. The methods of continuous observation and all-occurrence sampling were adopted for the preliminary observations of this study. Observation items recorded in this study were resting, feeding, ruminating, moving,

drinking, urinating, and defecating activities. Resting was defined as standing on the ground without moving and lying quiescently without ruminating. Ruminating was defined as chewing food and swallowing it followed by the subsequent regurgitation and final digestion of the food. Feeding was defined as eating green grass in the open air and man-made fodder from the troughs. Moving was defined as walking without any objectives. Drinking was defined as drinking fresh water from troughs in the enclosure. The percentage statistical method was adopted to analyze diurnal activity rhythms.

Table 1. Basic information of Qinling golden takin

Captivity No.	Name	Age (a)	Sex	Source
NO.1	XIEZI	11	♀	Fuping County, Shasnxi Province, China
	DAIZI	6	♀	Ningxi County, Shasnxi Province, China
	MU	6	♀	Taibai County, Shasnxi Province, China
	HEIZI	1	♂	SRRRRWA
	BAIZI	1	♂	SRRRRWA
NO.2	DUANJIAO	9	♂	Taibai County, Shasnxi Province, China
	YAOWAN	11	♂	Fuping County, Shasnxi Province, China
	ZHUANG	9	♂	Baoji City, Shasnxi Province, China
NO.3	JIAOMO	12	♂	Taibai County, Shasnxi Province, China
	CHUANGLIAN	6	♂	SRRRRWA
	XIAOQIANG	6	♂	Hu County, Shasnxi Province, China
	LAOSHEN	8	♂	Fengxiang County, Shasnxi Province, China
	RUO	7	♂	Zhouzhi County, Shasnxi Province, China

Results

Time budgets of golden takin in resting, feeding, ruminating, and moving activities

At daylight (from 9:00 a.m. to 4:00 p.m. in July), the average percentages of four activities, resting, feeding, ruminating, and moving, were 46.28, 34.82, 11.64, and 7.26, respectively. Therefore, resting occupied the biggest part and moving times was only a small part in all day's activities.

Time budgets of golden takin in drinking, urinating, and defecating activities

Compared with activities described above, the activity times of Qinling golden takin in drinking, urinating, and defecating were relatively fewer and they always twinkled in a rush time. Drinking was 1.92 times at daylight. Urinating was 0.54 times at daylight, and defecating was 0.92 times at daylight. (Table 2)

Time budgets of Qinling golden takin in different time scale

As shown in Table 3, different behaviors did not take equal amounts of time at different hours during daylight. From 14:00 to 15:00, resting was the most active behavior. The peak feeding activity appeared from 09:00 to 10:00. After Qinling golden takin ingesting the foods, urinating became the next peak activity between 10:00 to 11:00. After the golden takin finished feeding and ruminating, its moving was the main behavior between 11:00 and 12:00. This time budgets obviously formed a reasonable and physiological trend (Table 3).

Table 2. Time budgets of some behaviours of the Qinling golden takin at daylight

Activities	Drinking	Urinating	Defecating
Average times per day per head	1.92	0.54	0.92

Table 3. Time budgets of Qinling golden takin in different time scale

Time	Resting	Feeding	Ruminating	Moving
09:00-10:00	8.33%	76.17%	9.52%	5.98%
10:00-11:00	25.00%	17.43%	50.00%	7.57%
11:00-12:00	26.25%	23.75%	38.33%	11.67%
12:00-13:00	35.96%	27.19%	32.02%	4.82%
13:00-14:00	50.93%	17.76%	28.97%	2.33%
14:00-15:00	63.78%	20.54%	13.51%	2.16%
15:00-16:00	50.68%	13.12%	31.67%	4.52%

Effect of age on time budgets of golden takin

In this section, captive Qinling golden takins were divided into 3 groups according to sexual-maturity ages. Female takins reach sexual-maturity at the age of 3.5 year (Wu 1996) and 4 year (Liu 1999; Zhang 1983), which male golden takin reaches sexual-maturity at age of 4 (Wu 1996) and 5 (Liu 1999). Therefore, the takin population was classified into 3 groups by different age-scales, such as Middle-age (≥10 year old), Juvenile (≥5 year old), Sub-Juvenile (≤ 5 year old, ≥ 1 year old) and infant (≤1 year old) groups (Table 4). The results showed that resting and ruminating were the main behaviors in the Middle-age group, and moving was the least. In the Juvenile group, they spent most time in resting and ruminating. To the Infant group, resting and feeding possessed the biggest parts in time budgets. And moving was relatively more time consuming than that in other age groups.

Table 4. Different activity budgets in takin population of different ages

Ages	Resting	Feeding	Ruminating	Moving
Middle-age	35.40%	26.26%	34.45%	3.89%
Juvenile	38.56%	23.42%	32.51%	5.51%
Infant	33.36%	33.01%	19.14%	11.48%
Average	35.77%±2.62%	27.56%±4.93%	28.70%±8.34%	6.96%±4.00%

Discussion

From analyzing diurnal activity rhythms of the captive Qinling golden takins, the results showed that the resting (46.28% of the observation period) and feeding (34.82%) accounted for the ma-

jority of activity at daylight. Due to the heave body, resting was more than other behaviors, which was in accordance with studies of the wild takins (Zeng *et al*. 2001).

The captive Qinling golden takins' basic data of drinking, urinating and defecating activities were first revealed. The captive Qinling golden takins, under observation, spent relatively little time in drinking activities. Each individual went to drink only 1.92 times per day on average. Urinating and defecating activities were averaged to be 0.54 and 0.92 times per day. But the quantity of excretion was rather abundant each time and the general shape of dung was similar to the sheep's. (Bai *et al*. 2005) once reported how many times cattle had per day in drinking, urinating and defecating activities. And the results showed that drinking, urinating and defecating activities in cattle were obviously more than those of wild takins. Nevertheless, the results of captive Qinling golden takins were very similar to those of goat (Liu *et al*. 2001).

According to the analysis, the results demonstrated that the activity rhythms have correlation with temperatures. The captive Qinling golden takins usually avoided acting at the highest temperatures in the afternoon. This result was similar to that of wild takins' (Zeng *et al*. 2001). Peak activity often occurred between 11:00 a.m. and 12:00. Peak feeding activity often occurred between 9:00 a.m. and 10:00.a.m. Other researches have obtained similar results from observation for wild golden takins (Hu 1980; Deng 1981, 1984). Peak rumination often occurred between 10: 00 a.m. and 11:00 a.m. Of course, the ruminating timescale is next to the timescale of the active feeding, and this behavior was also accompanied to the resting. These characteristics of behaviors were similar to that of cattle (Zhao *et al*. 1998; Bai *et al*. 2005). Most resting took place between 2:00 p.m. and 3:00.p.m. During this time, many of the captive Qinling golden takins rested under tall trees in order to keep themselves cool. The captive Qinling golden takins usually remained resting until the sun was lower in the sky (Zeng *et al*. 2001).

The activity rhythms of the Qinling golden takins were affected by ages; this was expressed through differentiation of time budgets. As the ages of individuals increased, acting time gradually decreased. Middle-aged and juvenile takins were similar to each other in activity rhythms. With the wild takins (Zeng *et al*. 2001), their activity rhythms were the same as the captive individuals. For infant takins, however, there was an interesting feature that their feeding time was less than the time that they spent ruminating, which had not been reported before. With regard to this question, the author considered that infants relied on their dam's lactation, and they had a different way of feeding. This can be consulted from many species.

Even though the Qinling golden takins under our study were kept in the same enclosure, different individuals always acted independently from the rest in the same population, or they did not act up to most the population. For instance, between 09:00–10:00 and 12:00–13:00, most of the captive Qinling golden takins rested under the trees, while some other individuals were still feeding, or were doing other activities. Other reports indicate that there may be a sentry system that exists in some populations (Hu 1980; Ge 1988; Wu 1990). During our observation, the real reasons to the phenomena of acting behaviors in the different time levels were also revealed. In the same enclosure, juvenile takins of males and middle-aged takins of females always occupied the biggest territories and possessed the strongest powers, but the eldest takins and young takins were only able to follow them and evade themselves away. This rank relationships were some depth associated to the action behavior of golden takins, because the dominant individuals almost frequently shared all the superiorities, including feeding and mating and occupancy. Therefore, this finding should be revealed in the coming time.

Conclusions

The basic data of drinking which was 1.92 times at daylight, urinating which was 0.54 times at daylight and defecating which was 0.92 times at daylight were first revealed in captive Qinling golden takins. Their resting time and feeding time which were totally 81.1% of the observation period accounted for the majority of activity at daylight. During analysis, a new discovery came out and it was a correlation between the activity rhythms and temperatures. With the daily temperature rising, resting was gradually increased, but the moving activity was relatively reduced as well as feeding and ruminating. And the activity rhythms of the captive Qinling golden takins were affected by ages as well. With the age increasing, moving decreased and ruminating increased. Infants ingested a large number of foods, but ruminating time was less than that of middle-aged takin groups.

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